Exploring public support for climate change adaptation policies in the Mediterranean region: A case study in Southern Spain

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A B S T R A C T

The understanding of public perception to climate change is an essential factor in the development of adaptation policies. In the Mediterranean, agriculture, as the largest consumer of freshwater, has the highest potential to suffer adverse impacts of climate change. Future water availability predictions, conflicting interests among stakeholders and an increasing social concern about the environment further aggravate the situation. Therefore studying public support for adaptation policies can play a key role in successfully adapting the sector. The study site, approximately 36,000 hectares of rice fields in Seville (Spain), exemplifies an area in the Mediterranean where water needs to be carefully reallocated in view of the limitations anticipated by climate change scenarios; in particular where conflicts will arise between water for agriculture and water for 'natural' ecosystems. This paper proposes an ex-ante evaluation of the societal support for adaptation policies. A survey of 117 respondents was conducted and a Logit model utilized to analyze which predictors positively or negatively affect people's support for adaptation policies. Results suggest that the main barriers to support these policies were economic losses and low climate change concern whereas the primary motivation factor was environmental commitment. Additionally, the main socio-demographic determinants were gender, age, education and family structure. In order to improve societal support for climate change adaptation policies, implementing educational and awareness raising initiatives will be the main challenges for policy makers to overcome.

Keywords:
Climate change
Support for adaptation
Logit model
Water allocation
Mediterranean

1. Introduction

The complexity of understanding public perception of climate change hinders the development of adaptation policies. In the Mediterranean warming and future drying trends will result as a consequence of climate change (IPCC, 2007). However, efforts to develop climate change adaptation policies in this region have been met with a lack of concrete local measures that are understood and supported by citizens (Juhola and Westerhoff, 2011). Even in areas of strong environmental commitments, the success of various policy proposals has been mixed, reflecting a perception that the public view adaptation to climate change in opposition to economic development (Shwom et al., 2010). To advance understanding of Mediterranean public opinion on climate change, this paper

reports the barriers and motivations to public support for adaptation policies. We frame this analysis in an area where water scarcity is already a major issue, where all climate scenarios project further water limitations, and where water sustains agriculture in addition to an UNESCO world heritage site with exceptionally high biodiversity.

The debate on water for agriculture and water for nature is an environmental problem that has been at the centre of the European water policy debates (e.g. OJEC, 2000) and has generated widespread media attention. Adding the climate change aspect, environmental beliefs become more complex and public opinion is further polarized (Dunlap and McCright, 2008; Dietz et al., 2007). Moreover society is becoming increasingly concerned about the environment as societal well being continues to improve, so higher social demands are expected to be placed on water ecosystem's environmental quality. Thus, the increasing social awareness about environmental problems combined with adverse climate change predictions exacerbates the situation.

Given that water allocation is so controversial, decision-making processes often lead to conflicts among stakeholders (Iglesias et al., 2011) thus it is essential to incorporate the different interests of those affected by the consequences of decision making, including policy makers, farmers and the general public (Conde and Lonsdale, 2005; EU, 2007, Semenza et al., 2011). A good example of this intention is the water framework directive (WFD), which represents a benchmark in the design of water policies and greatly promotes stakeholder and public participation in decision- and policy-making processes.

We contribute to an understanding of public opinion towards water saving policies in view of climate change. First, while there is a considerable literature on attitudes of the European public towards environmental commitment and climate change concern (Eurobarometer Surveys on Climate Change, 2008, 2011; World Wide Views, 2009), these have depended on survey methods implemented on a large scale and have not examined the reasons behind the responses given by social groups that understand and have had to face a change in policy. This shortcoming of large surveys has been addressed by a number of studies that used focus groups (Stoll-Kleemann et al., 2001) or ethnography (Norgaard, 2006) to document rationales behind the answers (Shwom et al., 2010). However the limitation of these surveys is the size of the sample that may not represent a particular local problem that includes different stakeholders. Our study bridges the massive surveys and the focus approaches, examining the reasons behind the barriers and opportunities to support public policy.

Studies concerning people's support for adaptation policies have been less numerous than those dealing with social perception of climate change. There are a number of studies which assess support for adaptation policies by asking directly how much one would be willing to pay for certain adaptation measures (Hanemann et al., 2011; Ku and Yoo, 2010; Longo et al., 2012; Solomon and Johnson, 2009; Zografakis et al., 2010) and others which highlight the factors that influence stakeholders' willingness to adapt to climate change (Blazy et al., 2011; Bryan et al., 2009; Cameron, 2005; Hansen et al., 2004; Roncoli et al., 2001; Vogel and O'Brien, 2006).

Traditionally social and environmental psychology literature uses different types of scales and factor analysis to analyze social concern about climate change and environment (Davis et al., 2009, 2011; Michel-Guillou and Moser, 2006; Milfont and Duckitt, 2004). In most of these studies respondents are directly asked for their personal concern about climate change or their personal environmental commitment in general, without focusing on a specific case. Thus respondents may find it rather difficult to answer this type of questions which do not refer to a particular case and their perception of the environment or climate change may vary enormously to the reality. However, presenting a real case, where respondents only had to choose which policy option they consider more appropriate to implement at a known site, would avoid this problem, and analyzing the main reasons and causes of these answers would be much easier for the researcher.

This work attempts to develop a different methodology by presenting a real case (i.e. rice fields of Seville) where respondents are directly affected by the ecosystem services provided by the rice fields. In this study respondents lived in the local area, so the majority were aware of the rice fields and the associated water scarcity problems and as such any change produced in the ecosystem services of the rice fields could positively or negatively affect their well being.

In order to study societal perception of climate change and the most relevant determinants which promote or hinder people's support for adaptation policies within the Mediterranean region, we conducted a survey in several rural municipalities of the Guadalquivir River Basin (Southern Spain). As a case study we selected the rice fields of Seville, near Doñana National Park. The methodological process employed here integrates different components affecting respondents' support for adaptation policies to identify motivation and barriers to adaptation as well as socio-demographic determinants. A binary Logit model was utilized to evaluate the relative importance of these direct and indirect explanatory factors as well as examine the main factors influencing people's support for climate change adaptation policies. The results of this research are a valuable contribution to climate change policy in the Mediterranean since knowing how a local issue is perceived by informed citizens could help to inform the next steps of public action and deliberation on climate change policies.

2. Sustainability of rice production in the Guadalquivir River basin and adaptation to climate change

The studied area represents approximately 36,000 hectares of rice field (*Oryza sativa* L.) located at the mouth of the Guadalquivir River in the province of Seville (Southern Spain). Nowadays the sustainability of rice production in Seville is jeopardized by four main threats; firstly, the high water need of rice fields in a Mediterranean watershed with limited water availability. Rice fields consume huge quantities of water (the average dose of water irrigation supply is approx. 14,000 $m^3\ ha^{-1}$), since it is the crop with the highest water consumption in the Guadalquivir basin and rice production

faces water conflicts among other water users (Berbel et al., 2011). Secondly, the decrease in financial support from the Common Agricultural Policy over time, the liberalization of the EU market and the lowering of intervention prices represent an important threat to the rice sector (CAP, 2007). Thirdly, regarding the fact that water for rice competes with water for protected natural ecosystems (i.e. wetlands of Doñana protected by UNESCO) water allocation will be more disputed as societal environmental concern increases. Finally, the adverse climate change predictions which describe lower water availability and higher water demands in the Guadalquivir basin. These climate projections are supported by a multitude of studies (AEMET, 2010; Giorgi and Lionello, 2008; Hoerling et al., 2012; Nieto and Rodríguez-Puebla, 2006) so its significance level is considered relatively high. It is likely that a change in wintertime Mediterranean precipitation towards drier conditions has occurred over the period 1902–2010 whose magnitude cannot be reconciled with internal variability alone (Hoerling et al., 2012). This observational evidence of century-long negative trends in regionally averaged precipitation and discharge from numerous rivers (Hoerling et al., 2012) has clearly been observed in the Guadalquivir basin and has accelerated towards the turn of the century (Nieto and Rodríguez-Puebla, 2006). Projections of further drying are almost certain (Giorgi and Lionello, 2008; Navarra and Tubiana, 2013). Using a multi-model simulations, Mariotti et al. (2008) show alterations of 21st century Mediterranean water cycle characteristics. By 2070–2099 the average of the models predicts a 20% decrease in land surface water availability due to precipitation reduction and warming-enhanced evaporation, with a remarkably high consensus among analyzed models.

Generally policy makers develop new policies in response to these kinds of threats and concerns as they may seem sufficiently important on which to base decisions. However, the relative importance of these threats or concerns when developing new policies greatly depends on the time scale (van Delden et al., 2011). In the lower Guadalquivir as in many other water scarce regions, there is an immediate need to adapt water usage based on on-going market changes and demands for water for other uses, especially maintenance of wetlands (Wu et al., 2012). Thus the first three threats explained above, those which have immediate and actual consequences, are usually taken into consideration during decision-making processes (Garrick et al., 2009). Whereas the prospect of climate change may be a more-distant concern to local stakeholders and as such its influence on policy makers can be very low. Since climate change could be considered as a long term threat, the uncertainty of climate change predictions may seem to be very high and they may not be a determinant when developing new policies. Nevertheless, a high significance level of climate change predictions increases the importance of the projections on which to base policy decisions (Charlesworth and Okereke, 2010). In the lower Guadalquivir, as said above, the significance level of climate change predictions is considerably high, given the multitude of studies which claim the same adverse predictions (Giorgi and Lionello, 2008; Hoerling et al., 2012; Mariotti et al., 2008; Navarra and Tubiana, 2013; Nieto and Rodríguez-Puebla, 2006). Thus, we could assume that despite the fact that climate change predictions represent a long term threat they ought to be considered sufficiently important when defining new policies. Having assessed all the major threats and concerns, the best way to adapt the rice fields to climate change and ensure the sustainability of rice production in the Guadalquivir basin, could be to reduce water consumption and change the current land-use in some determined areas. However, since stakeholders hold different perspectives about which water policies should be implemented, water conflicts are expected to arise. Thus incorporating public opinion into the policy-making processes on adaptation seems to be fundamental in increasing the sustainability of rice production regarding social, economic and ecological aspects.

3. Methods

3.1. *Framework and rationale for model development*

The methodological process used here integrates different components affecting individuals' support for climate change adaptation policies in order to identify their main motivation and barriers. Support for adaptation policies depends on a small set of determinants related to individuals' attitudes, which we call motivation and barriers. Additionally, motivation and barriers are affected by a large set of determinants related to individuals' socio-demographic characteristics. Thus the analysis process includes the link between direct explanatory factors such as motivation and barriers to support adaptation policies, with indirect factors affecting social behaviour (Fig. 1). As seen, in this analysis the main motivation factor to people's support for policies aimed at adapting the rice fields is individuals' environmental commitment, while the main barriers are individuals' economic losses and low climate change concern.

3.2. *Data collection*

3.2.1. *The sample*

A survey of 117 individuals in the municipalities close to the rice fields (Aznalcázar, Dos Hermanas, Isla Mayor, Las Cabezas de San Juan, Los Palacios y Villafranca, Puebla del Río and Utrera) of the province of Seville (Spain) was carried out in February 2012. Interviews were conducted face to face in the main streets and squares of the villages and lasted for

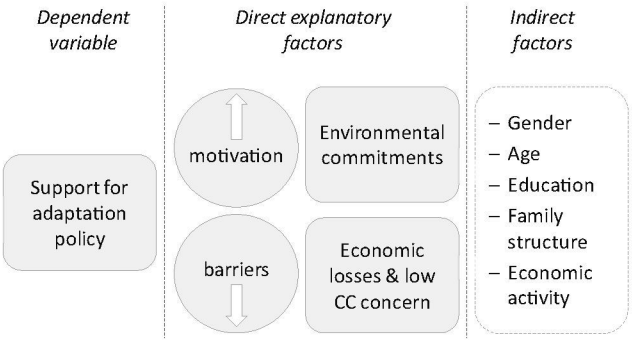

Fig. 1 – Proposed framework for analyzing individuals' support for climate change adaptation policies.

approximately 20 min. The random sample included policy makers, rice farmers and citizens who lived near the rice fields. Thus the sample included people directly affected by the possible changes implemented in the rice fields, and other people who were unrelated to agriculture and water management communities but were equally affected by the potential water allocation decisions in the study area. Interviews were spread across different days of the week and across different times of the day in order to ensure all population sub groups had an equal chance of being interviewed. Pilot testing of the survey instrument was conducted prior to the main survey. Along with expert judgement, the results from the pilot were used to refine the questions asked in the main survey.

3.2.2. *Questionnaire*

The value of respondents' support for climate change adaptation policies was estimated by asking five different questions related to the adaptation of the rice fields to climate change (Appendix A, from question 1–5). The answers of these questions could be considered as either *positive, negative* or *it does not influence on the support for these policies*. The positive answers were weighted as 1, the negative ones as −1, and 0 whether the answer was considered as it did not influence. Afterwards all the values obtained in these five questions were summed up in order to estimate respondent's support for climate change adaptation policies. Finally, respondent's value of supporting adaptation policies was measured as *High* when the sum was above 0 and *Low* when below 0. The value of respondents' environmental commitment was estimated by the same methodology used for the support for climate change adaptation policies (Appendix A, from question 6–8). The value of respondents' concern about climate change and economic losses was measured by questions 9 and 10 respectively.

3.2.3. *Empirical model*

The basic aim of our analysis was to describe the way in which individuals' support for adaptation policies varies due to their motivation and barriers. In our analysis we treated respondents' support for adaptation policies as the response or the dependent variable of interest, and respondent's environmental commitment, economic losses and climate change concern as predictors. The dependent variable has two categories: *High* and *Low* support for adaptation policies. All predictors were treated as categorical variables, i.e. discrete factors with two categories for each predictor. Thus it allowed us to classify the data in terms of the numbers of *High* and *Low* support for adaptation policies in eight different groups which were defined by combining values of predictors such as environmental commitment; economic losses and climate change concern.

To determine the support for climate change adaptation policies considering direct and indirect factors, we have considered two different models. A Logit model was developed to evaluate the relative importance of direct explanatory factors (Fig. 1) which influence support for adaptation policies. In a further iteration, socio-demographic determinants (indirect factors) are considered to explain the environmental commitments and climate change concern.

Ideally, this would be estimated as a simultaneous system of multinomial limited dependent variable models, the first showing the support for climate change adaptation policies while the second shows the determinants of the environmental commitment and climate change concern. As an alternative, it is possible to estimate individual equations. This would normally lead to a loss of statistical efficiency, however, we can assume that the relationship between the equations is unidirectional (the equation for the support for climate change depends upon the environmental commitment and climate change concern but the reverse is not true). In this case, the relationship is triangular in nature and can be estimated efficiently with independent equations (Greene, 1993). This solves the endogeneity problem related to the decision of support for climate change adaptation policies.

Eq. (1) describes the final Logit model of a binomial distribution B(·),

$$\pi_i = \wedge[x_i'\beta] \tag{1}$$

where $\wedge[\cdot]$ denotes the univariate logistic cumulative distribution function (CDF), that is:

$$\wedge[\cdot] = \frac{1}{1+e^{-x_i'\beta}} \tag{2}$$

x_i are the dummy explanatory variables and β the estimated coefficients for these direct explanatory factors.

π_i indicates the probability of success (Prob$[Y_i = 1|x_i]$. That is the probability of support for climate change adaptation policies conditioned to the explanatory factors for each individual.

Tools for analyzing the marginal effects in the regressions can be found in modern econometrics (Greene, 2008). Since $\partial E[y_i|x_i]/\partial_{xk} = \wedge[x_i'\beta][1 - \wedge[x_i'\beta]]|_{\beta=\beta*}.\beta_K$ being $\wedge[x_i'\beta][1 - \wedge[x_i'\beta]]|_{\beta=\beta*}$ the density function of the logistic CDF, and therefore is always positive, the sign of the estimated coefficients in the logit regression can be interpreted as the sign of the marginal effects. That is, those coefficients with a positive estimated sign would imply that the associated factors increase the probability of support for climate change adaptation policies. For the negative estimated coefficients, the probability of support would be reduced when the agent presents this characteristic.

To select the relevant factors to explain the dependent variable we have considered those variables being individually significant in the case of individual variables. For the sets of variables (such as age or education) likelihood ratio tests were conducted in order to determine the global effect of the factor.

4. Results

4.1. *Mapping interactions of public choice*

In our analysis support for adaptation policies was affected by individuals' motivations and barriers in the same way as motivations and barriers were affected by socio-demographic characteristics. The percentage of respondents with *High* support for adaptation policies and environmental commitment was higher in males, younger respondents and in those with higher educational attainment (Fig. 2). The percentage of respondents with *High* climate change concern was higher in females, younger respondents and in those with higher

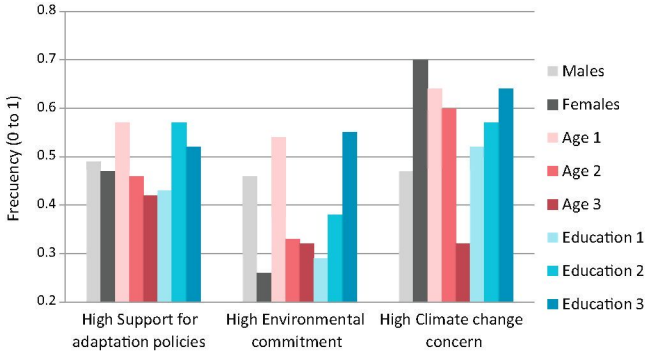

Fig. 2 – Frequency distribution of individual characteristics for support for adaptation policies, environmental commitment and climate change concern.

educational attainment. The majority of rice farmers (i.e. those with the potential of experiencing *High* economic losses) were men between 30 and 65 and with different levels of education.

Fig. 3 shows the correlations amongst people's support for climate change adaptation policies and its motivation and barriers, and further the correlations amongst the motivation and barriers and the socio-demographic determinants. These correlations are rather small, due to the fact that the determinants were binary factors which could only take 0 or 1 values. As seen, support for adaptation policies and its motivation factor had a positive correlation, so the higher environmental commitment the higher support for adaptation policies. Economic losses had a negative correlation with support for adaptation policies, so the higher the economic loss the lower the support for adaptation policies. Climate change concern had a positive correlation, meaning that the higher climate change concern, the higher the support for adaptation policies. According to the correlations among the socio-demographic determinants and the motivations and barriers, men, younger respondents and the most educated had a positive correlation with environmental commitment, whereas women, younger respondents and those with children had a positive correlation with climate change concern.

Graph 1 of Fig. 4 represents the relationship between the correlations of the determinants of support for adaptation policies and the determinants of environmental commitment. The correlations of the determinants can be divided into two different groups, where one group had only positive correlations in both axes and the other group had only negative ones. Thus it is noticeable the great relationship between the correlations of support for adaptation policies and environmental commitment. As environmental commitment is positively correlated with support for adaptation policies we could assume the fact that younger, male and more educated individuals might have higher support for adaptation policies. Graph 2 shows the relationship between the correlations of support for adaptation policies and climate change concern. These correlations may also be split up into two groups, where one group had only positive correlations in both axes and the other group only negative ones, with the exception of the determinant of gender. It reflects that the support for adaptation policies and climate change concern were directly

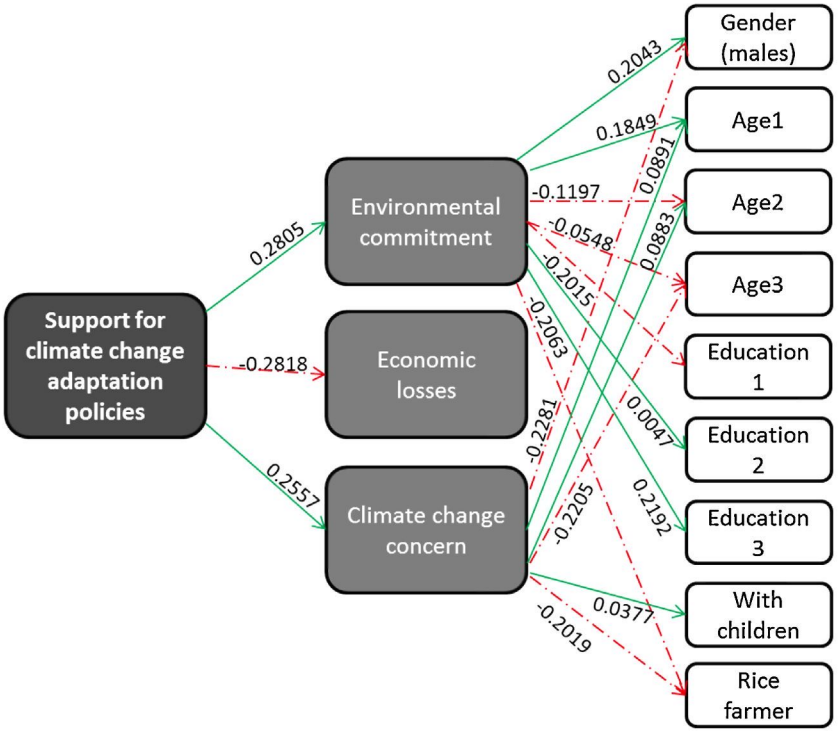

Fig. 3 – Mapping correlations of predictors of people's support for climate change adaptation policies. Figures indicate the correlation value between the attributes. Red dashed arrows indicate negative correlation and green solid arrows indicate positive correlation.

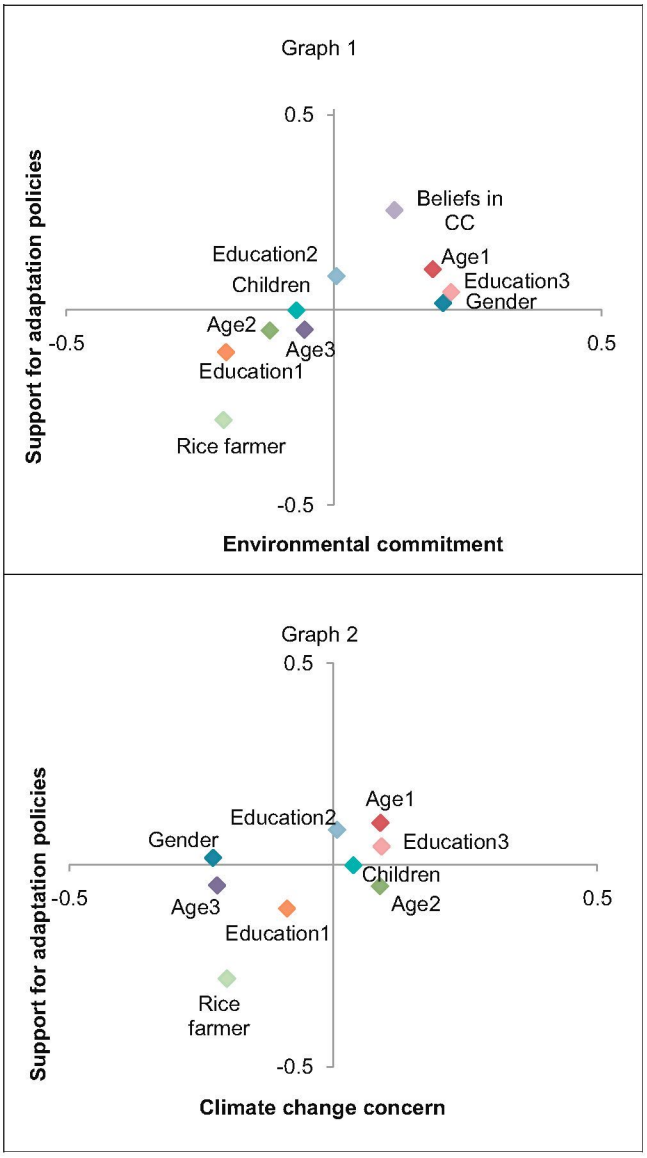

Fig. 4 – Graph 1: correlations between the determinants and support for adaptation policies and environmental commitment. Graph 2: correlations between the determinants and support for adaptation policies and climate change concern.

correlated. As we can see, the level of correlation between people's support for adaptation policies and climate change concern increased with the educational attainment and decreased with age and economic losses. Thus as climate change concern and the support for adaptation policies were positively correlated we could assume that younger, female individuals and those with children might have higher support for adaptation.

4.2. *Modelling support for climate adaptation*

We first estimated the model corresponding to respondent's support for adaptation policies using a binary Logit for the direct explanatory factors. Table 1 presents a logistic regression for support for adaptation policies, environmental commitment and climate change concern. The regression of support for adaptation policies shows that environmental commitment, economic losses and climate change concern were all significant at 5%. The coefficients of both environmental commitment and climate change concern were positive, so a *High* environmental commitment and climate change concern provided a higher probability of having a *High* support for adaptation policies. The positive effect of *High* environmental commitment may be explained by the fact that most adaptation measures proposed in the questionnaire were related to reducing the amount of water for irrigation and changing the current land-use of the rice fields, i.e. most of them could be considered environmentally friendly measures as well as a possible solution for the region's recent water scarcity problems. The positive coefficient of climate change concern could be accounted for by the fact that citizens who did not believe in climate change predictions were less likely to support climate change adaptation policies whereas the coefficient of economic losses was negative, confirming the fact that rice farmers were less likely to have a *High* support for adaptation policies. This can be explained by the fact that most rice farmers saw climate change adaptation measures as economic losses, due to the current public subsidy for growing rice in Southern Spain is much greater than the subsidy for other types of local agriculture such as crops of orange, sunflower, cattle, aquaculture, etc. and any adaptation measure for the rice fields related to either water reduction for irrigation or land-use change might entail economic losses for rice farmers.

The significant socio-demographic determinants in estimating respondents' environmental commitment were found to be gender, age, education and economic losses (Table 1). The coefficient of males was positive and significant at 1%, indicating that males were more likely to have higher environmental commitment. The age of respondents was classified into three groups, ranging from 15 to 29 years old '*Age1*', from 30 to 65 '*Age2*' and over 65 '*Age3*'. In order to avoid exact collinearity, *Age2* was excluded from the regression analysis and *Age1* and *Age3* were analyzed in relation to *Age2*. The coefficient of *Age1* was positive and significant at 10%, suggesting that young citizens were more likely to have higher environmental commitment than middle-age citizens. However, *Age3* also had a positive coefficient, implying that older citizens were more likely to have higher environmental commitment. Education level was divided in three different groups according to the age when respondents' education terminated. The three groups of education were *Education1* for those whose education ended before 16 years of age, *Education2* for those who studied until they were 20 and *Education3* for those who studied at university level. *Education1* had a negative coefficient showing that fewer educated citizens were less likely to have higher environmental commitment. *Education3* had a positive coefficient and was significant at 10%, so the most educated citizens were more likely to have *High* environmental commitment. According to the economic losses, the fact of being a rice farmer had a negative effect on the environmental commitment since economic losses had a negative coefficient and it was significant at 5%.

Table 1 – Logit model coefficient estimates that explain support for adaptation policies.

Dependent variables	Independent variables	Value [absolute value of z]
Support for adaptation policies	Environmental commitment (high)	0.998 [2.38]**
LR chi^2(3) = 21.42	Economic losses (rice farmer)	−1.678 [2.08]**
Log likelihood = −70.28	Climate change concern (beliefs in climate change)	0.885 [2.14]**
	Constant	−0.795 [2.17]**
Environmental commitments	Gender (male)	1.439 [2.93]***
LR chi^2(6) = 24.98	Age1	0.943 [1.87]*
Log likelihood = −64.98	Age3	0.646 [0.99]
	Education1	−0.283 [0.50]
	Education3	1.162 [1.82]*
	Economic losses (rice farmer)	−2.194 [2.53]**
	Constant	−1.746 [2.68]***
Climate change concern	Gender (male)	−1.559 [3.07]***
LR chi^2(5) = 26.96	Age1	0.660 [1.08]
Log likelihood = −66.66	Age3	−2.541 [3.60]***
	With children	1.306 [2.32]**
	Rice farmer	−1.251 [1.99]**
	Constant	0.911 [1.63]

117 Observations.
* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

The significant socio-demographic determinants for assessing respondent's climate change concern were gender, age, having children and economic losses. The coefficient of males was negative and significant at 1%, indicating that women were more likely to believe in climate change predictions. *Age1* had a positive coefficient whereas *Age3* had a negative coefficient at 1%, showing that young citizens were more likely to have higher climate change concern than middle-age citizens whilst older citizens were less likely to have higher climate change concern. Moreover, the coefficient of *With Children* was positive and significant at 5%, so citizens with children were more likely to believe in climate change predictions than citizens without children. It may be explained by the fact that citizens with children tend to be more concerned about the future and therefore they were also more concerned about climate change. Once again, economic losses acted as a determinant and the fact of being a rice farmer entailed a negative effect on the climate change concern.

Finally based on Logit model estimates we calculated the probabilities of having *High* and *Low* support for adaptation policies (Table 2). The groups are classified in terms of environmental commitment, economic losses and climate change concern. It shows that the group with the highest probability of having a *High* support for adaptation policies is represented by people with a *High* environmental commitment, professions other than that of rice farmer and a *High* climate change concern. Whereas the group with the highest probability of having a *Low* support is characterized by people with a *Low* environmental commitment, rice farmer profession and a *Low* climate change concern.

5. Discussion and conclusions

There are some major limitations of our findings. First, our sample is relatively small and covers only a local area within the Mediterranean region. Second, our list of proposed

Table 2 – Estimated probability for supporting adaptation policies in each group based estimated from the Logit model.

Group	Characteristics of the group based on questionnaire responses			Probability for supporting adaptation policies in each group (0–1)	
	Environmental commitment	Potential economic loses	Climate change concern	High support	Low support
1	High	Rice farmer	High	0.36	0.64
2			Low	0.19	0.81
3		Other	High	0.75	0.25
4			Low	0.55	0.45
5	Low	Rice farmer	High	0.17	0.83
6			Low	0.08	0.92
7		Other	High	0.52	0.48
8			Low	0.31	0.69
Total				0.48	0.52

adaptation policies for the rice fields does not capture the full range of possible adaptation policies to be implemented, particularly since it does not propose additional infrastructure, subsidies, or voluntary market solutions. Third, our econometric model is estimated as a triangular system assuming unidirectional relationships among the variables which could be an interesting topic to discuss in further research. Additionally, in the context of the water policy model the factors considered are likely to be only the most relevant ones and other important future factors are not considered. Future research is needed to further understand the underlying water availability and adaptation.

Despite these limitations, the analysis advances our knowledge of differing public support for climate change adaptation policy by providing increased comprehension of the variety of reasons people oppose or support adaptation policies and their relationship to the socio-demographic characteristics to predict adaptation policy support in a geographically and socially diverse country.

Our results confirm the main findings of previous studies which have proposed that age, gender, education and residence are the main determinants of environmental attitudes (Van Liere and Dunlap, 1980; Fransson and Gärling, 1999). Nevertheless, in the case of the gender determinant our findings disagree with many previous studies which state that women do tend to have higher environmental commitment than males (Zelezny et al., 2000; Milfont and Duckitt, 2004; Eurobarometer Survey Towards Water, 2009), whereas our results claim the opposite. It may be explained by the fact that questions of traditional literature generally analyze the individual's environmental concern by asking respondents to mark a rating on a numerical scale (Fransson and Gärling, 1999; Milfont and Duckitt, 2004). Yet, our study attempts to assess the individual's environmental commitment in terms of their awareness about environmental problems produced by the rice fields. As males in general are more involved in agricultural activity in southern Spain, they are more concerned about environmental problems produced by farming. Thus it is probably that for this reason we found a relationship between gender and environmental commitment that differs from the traditional literature. The findings drawn from the rest of socio-demographic determinants confirmed those of the Eurobarometer Survey Towards Water (2009), where the environmental concern increased with the level of education and decreased with age.

Regarding climate change concern, we found that the significant determinants were gender, age, the fact of having children and rice farming as a profession. The Eurobarometer Surveys on Climate Change (2008, 2011) claims that concern about climate change is positively correlated with the level of education, however, despite finding also a positive correlation in our study, it was not significant at 10%. The Eurobarometer Surveys on Climate Change (2011) states that climate change concern is inversely correlated with age and that women are more likely to describe climate change as a serious problem which confirms our findings. Moreover individuals with children were more likely to have higher climate change concern but not more likely to have higher environmental commitment. This could be explained by the fact that individuals with children are more concerned about future uncertainties such as climate change, whereas environment is already viewed as a current issue.

In our analysis environmental commitment and climate change concern are not driven by the same social characteristics, as we would have expected. This reflects the theory that choice is driven by both cultural and rational approaches. The individuals that have relatively well formed views about climate change are guided by values and beliefs that result from education and social responsibility. In contrast, individuals that may suffer personal costs derived from their decision reflect a rational actor model.

According to the results, it could be assumed that in the study site it is necessary to address social motivations and barriers and some socio-demographic characteristics in order to increase societal support for climate change adaptation policies. Thus, policy can play an essential role in improving societal support by interacting with predictors so some policy recommendations could be proposed to facilitate societal support for climate change adaptation. Firstly, societal environmental commitment and climate change concern can be fostered by the implementation of environmental information and education policies. The European Environment Agency (2007) recommends social environmental education as an adaptation measure to climate change. These types of policies aim to enhance the environmental and climate change awareness of society which would positively influence societal support for adaptation policies (Semenza et al., 2011). Secondly, economic losses are a fundamental barrier to the support of adaptation policies due to the fact that public rice subsidies are much higher than those for the rest of the regions' crops. So any land-use change or rice crop surface reduction would suppose a personal economic loss for rice farmers. Therefore, it is essential to promote other crops better adapted to the adverse effects of climate change such as those which consume less water as well as to attempt to maintain farmer's current well being. This encouragement to cultivate other crops better adapted to climate change should also be based on information and education policies addressed to the farmer community.

Finally the socio-demographic determinants which might increase societal support for adaptation policies seem to be age, education level and the fact of having children. The improvement of some socio-demographic attributes of the population is not an easy task to carry out by the implementation of environmental, climate change or agricultural policies. However, the implementation of a better education and training policies in rural areas could have direct effects on societal support for adaptation policies. Regarding age, as younger individuals tend to have higher support for adaptation policies, it may be expected that the present situation will improve over time, since future generations will have higher support for adaptation policies than the current ones.

Our study in the rice fields of Seville shows that fewer than 50 percent of the public had a *High* support for climate change adaptation policies. Therefore, there is considerable potential for improving societal support for adaptation policies in the region. Our study has shown that, while environmental commitment is an important motivation factor to individuals' support for adaptation policies, barriers such as economic losses and low climate change concern also play a key role.

Motivation and barriers are affected by demographic determinants, which indirectly influence individuals' support for adaptation policies. In this study, the main socio-demographic determinants which affected people's preferences were age and education. Future work may consider a deeper assessment of social attitude towards climate change as well as the role of socio-demographic determinants. Consequently, this would be particularly relevant for increasing people education level in order to enhance people support for adaptation policies. To this end, a choice modelling method based on public opinion using field surveys seems to be particularly appropriate.

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Appendix A

Questions in relation to support for adopting climate change adaptation measures ($N = 117$).

	Answers (weighting value)	% (N)
Support for adopting climate change adaptation measures		
1. Do you think the public administrations should invest funds in adapting the rice fields of Seville to climate change?	Yes (1)	52.1 (61)
	No (−1)	23.9 (28)
	Do not know (0)	23.9 (28)
2. Given the plausible water scarcity produced by climate change, do you think it is desirable to reduce water for irrigation as an adaptation measure to climate change?	Yes (1)	49.6 (58)
	No (−1)	51.4 (59)
	Do not know (0)	0.0 (0)
3. Given the increase of water scarcity and water needs of rice fields due to global warming, would you prefer to increase, maintain or decrease the amount of water for irrigation in the rice fields?	Maintain (−1)	49.6 (58)
	Increase (−1)	15.4 (18)
	Decrease (1)	35.0 (41)
4. Given the water scarcity which climate change may produce, do you think the area of the rice fields of Seville should be reduced as an adaptation measure to climate change?	Yes (1)	39.3 (46)
	No (−1)	41.9 (49)
	Do not know (0)	18.8 (22)
5. If as an adaptation measure you could change the land-use in some areas of the rice fields of Seville, would you prefer to devote this area to other types of crops, livestock, natural wetlands or not to change the current land-use?	Not to change (−1)	32.5 (38)
	Other crops (1)	40.2 (47)
	Livestock (1)	8.5 (10)
	Wetlands (1)	18.8 (22)
Environmental commitment		
6. Do you belong to an environmental group?	Yes (1)	3.4 (4)
	No (0)	96.6 (113)
	Do not know (0)	0.0 (0)
7. Have you heard about the conflicts between farmers and environmental groups due to the environmental problems generated by rice production?	Yes (1)	52.1 (61)
	No (−1)	47.9 (56)
	Do not know (0)	0.0 (0)
8. Do you think rice production causes environmental problems in the wetlands of Doñana?	Yes (1)	17.1 (20)
	No (−1)	52.1 (61)
	Do not know (0)	30.8 (36)
Climate change concern		
9. Do you believe in the climate change projections of AEMET which predict higher temperatures and less precipitation in Andalusia?	Yes (=High (1))	56.4 (66)
	No (=Low (0))	43.6 (51)
Economic losses		
10. Do you have a financial stake in rice production in the Guadalquivir basin?	Yes (1)	13.7 (16)
	No (0)	86.3 (111)

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